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<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top; padding: 5px;"> <p>(21) International Application Number: PCT/SE98/01214</p> <p>(22) International Filing Date: 23 June 1998 (23.06.98)</p> <p>(30) Priority Data: 9702420-2 25 June 1997 (25.06.97) SE</p> <p>(63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Application US Not furnished (CIP) Filed on Not furnished</p> <p>(71) Applicant (for all designated States except US): ALFA LAVAL AB [SE/SE]; Hans Stahles väg, S-147 80 Tumba (SE).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): BLOMGREN, Raif [SE/SE]; Älgvägen 13, S-239 34 Skanör (SE). KNUTSSON, Anders [SE/SE]; Diamantvägen 1B, S-373 00 Jämsjö Slätt (SE).</p> <p>(74) Agent: AXELSSON, Nils, Åke; Alfa Laval AB, Patent Dept., S-147 80 Tumba (SE).</p> </td> <td style="width: 50%; vertical-align: top; padding: 5px;"> <p>(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report. In English translation (filed in Swedish).</i></p> </td> </tr> </table>			<p>(21) International Application Number: PCT/SE98/01214</p> <p>(22) International Filing Date: 23 June 1998 (23.06.98)</p> <p>(30) Priority Data: 9702420-2 25 June 1997 (25.06.97) SE</p> <p>(63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Application US Not furnished (CIP) Filed on Not furnished</p> <p>(71) Applicant (for all designated States except US): ALFA LAVAL AB [SE/SE]; Hans Stahles väg, S-147 80 Tumba (SE).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): BLOMGREN, Raif [SE/SE]; Älgvägen 13, S-239 34 Skanör (SE). KNUTSSON, Anders [SE/SE]; Diamantvägen 1B, S-373 00 Jämsjö Slätt (SE).</p> <p>(74) Agent: AXELSSON, Nils, Åke; Alfa Laval AB, Patent Dept., S-147 80 Tumba (SE).</p>	<p>(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report. In English translation (filed in Swedish).</i></p>
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<p>(54) Title: PLATE HEAT EXCHANGER</p> <div style="text-align: center; margin: 20px 0;"> </div>				
<p>(57) Abstract</p> <p>The present invention concerns a plate heat exchanger for at least two heat exchanging fluids which heat exchanger is permanently joined and comprises at least one core of plates with corrugated heat exchanging plates (1-4) creating plate interspaces between each other, at least two end plates (5) as well as inlet devices (6) and outlet devices (6) for the heat exchanging fluids. At least one of the end plates (5) is equipped with at least one port hole communicating with an inlet channel or an outlet channel. The plate heat exchanger is among other things characterized by the fact that at least one of the mentioned inlet devices (6) and outlet devices (6) comprises both a connection part (7) equipped with a channel and a transition part (8) with an envelope surface and equipped with a channel. An intersectional line between an imaginary elongation of the mentioned envelope surface in the direction of the generatrix for the envelope surface in every point of contact between the envelope surface and the end plate (5) on one hand and a plane comprising contact areas within the plate interspaces between the two heat exchanging plates (1, 2) that are closest to the transition part (8) in the core of plates on the other hand circumscribes a plurality of connecting points (10) between the mentioned two heat exchanging plates (1, 2).</p>				

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Plate heat exchanger

The present invention concerns a plate heat exchanger for at least two heat exchanging fluids which heat exchanger is permanently joined and
5 comprises at least one core of plates with corrugated heat exchanging plates creating plate interspaces between each other, at least two end plates as well as inlet devices and outlet devices for the heat exchanging fluids.

10 Technical sphere

Permanently joined plate heat exchangers are used to an increasing extent. The joining together may be done by brazing but also welding and gluing are used. At a pressure overloading a permanently joined plate heat
15 exchanger leakage will arise and the leakage is generally located to the port areas and/or the circumferential areas of the heat exchanging plates in connection to the inlet and outlet channels. The plate heat exchanger has within the port areas of the plates relatively large projected areas without connecting joints between the heat exchanging plates. Upon these areas
20 forces from pipe loads and fluid pressure are acting. The joints which are situated closest to the port areas of the plates run the risk of being overloaded and torn up.

Prior art

25

US,A,5 462 113 shows a plate heat exchanger for three fluids. The heat exchanger comprises a core of plates with heat exchanging plates, end plates and inlet devices and outlet devices for the heat exchanging fluids. The attachment of the end plate 12 to the extra sealing plate 16 is wide in

comparison with the port channel for the heat exchanging fluid R1 and will probably contribute to an increased resistance to pressure load. The resistance may still be improved.

5 Summary of the invention

The purpose of the invention is to create a stronger permanently joined plate heat exchanger for at least two heat exchanging fluids. The invention thus comprises a plate heat exchanger for at least two heat exchanging
10 fluids which heat exchanger is permanently joined and contains at least one core of plates with corrugated heat exchanging plates creating plate interspaces between each other, at least two end plates as well as inlet devices and outlet devices for the heat exchanging fluids. Each one of the heat exchanging plates is equipped with at least four port holes creating
15 an inlet channel and an outlet channel through the core of plates for each one of the fluids. At least one of the end plates is equipped with at least one port hole in communication with an inlet channel or an outlet channel. The inlet channels and the outlet channels for a first and a second fluid, respectively, are in fluid communication with a first and a second set of
20 plate interspaces, respectively.

At least one of the mentioned inlet devices and outlet devices comprises both a connection part equipped with a channel and a transition part with an envelope surface and equipped with a channel, the channel in the
25 transition part fluid tightly connecting the channel in the connection part with one of the port holes in one of the end plates. An intersectional line between an imaginary elongation of the mentioned envelope surface in the direction of the generatrix for the envelope surface in every point of contact between the envelope surface and the end plate 5 on one hand and a

plane comprising contact areas in the plate interspace between the two heat exchanging plates that are closest to the transition part in the core of plates on the other hand circumscribes a plurality of connecting points between the mentioned heat exchanging plates.

5

The present form of execution of a heat exchanger shows due to the wide attachment to the end plate of the transition part in comparison with the port channel a larger pressure durability than before in this exposed area.

10 List of drawings

Figure 1 shows in a perspective view a permanently joined plate heat exchanger of a conventional kind for two heat exchanging fluids.

15 Figure 2 shows in a perspective view a part of a permanently joined plate heat exchanger according to the invention whereby only one inlet or outlet device and the closest to this device situated part of the heat exchanger are shown.

20 Figure 3 shows in a cross-section the inlet or outlet device, the end plate and four of the heat exchanging plates in the core of plates according to figure 2.

Description of modes of execution

25

The plate heat exchanger in figure 1 is of a conventional kind and comprises a core of plates with heat exchanging plates 1, end plates 5 and inlet devices 6 and outlet devices 6 for two heat exchanging fluids.

Figure 2 shows a part of the plate heat exchanger according to the invention. The figure shows a core of plates with heat exchanging plates 1, end plates 5 as well as an inlet device or an outlet device for a heat exchanging fluid, the inlet or outlet device comprising a connection part 7
5 and a transition part 8.

How the construction appears in cross-section is evident from figure 3, where for the sake of simplicity only three heat exchanging plates 1-3 have been included. The core of plates may of course be executed in the wished
10 thickness with the wished amount of heat exchanging plates due to the effect need, the space which is available for the installation etc. The construction according to figure 3 however differs from the one according to figure 2 in such a way that the transition part 8 in figure 3 has been executed in one piece with the end plate 5 while the transition part 8 in figure 2
15 afterwards has been added to the end plate 5.

The connection part 7 is equipped with an inner channel and aimed at being connected to a pipe system in a plant of some kind. The transition part 8, also this one equipped with an inner channel, fluid tightly connects
20 the channel within the connection part 7 with a port hole in an end plate 5. The transition part 8 may be executed in one piece with the connection part 7 and/or, as mentioned above, with the end plate 5.

An intersectional line between an imaginary elongation of the envelope surface of the transition part 8 in the direction of the generatrix of the
25 envelope surface in every point of contact between the envelope surface and the end plate 5 on one hand and a plane comprising contact areas within the plate interspace between the two heat exchanging plates 1, 2 situated closest to the transition part 8 in the core of plates on the other

hand circumscribes a plurality of connecting points 10 between the mentioned two heat exchanging plates 1, 2. As a further accentuation of the determinations an intersectional line between an imaginary elongation perpendicular to the plates 1-5 of the envelope surface for the transition
5 part 8 on one hand and the mentioned plane comprising contact areas in the plate interspace between the two heat exchanging plates 1, 2 closest to the transition part in the core of plates on the other hand may circumscribe a plurality of connecting points 10 between the mentioned heat exchanging plates 1, 2. In connection to the elongation of the envelope
10 surface one takes as a starting point a contact line between the mentioned envelope surface and the end plate 5.

The mentioned intersectional line may, depending on the plate size, circumscribe 2-200, preferably 3-100 and most preferred 5-50 connecting
15 points 10. The circumscribed connecting points 10 are peripherally situated around the inlet or outlet channel and are present mainly evenly distributed over the present plate areas within an undivided circular sector with a central angle of at least 90 degrees, preferably more than 225 degrees and most preferred 360 degrees where the centre of the circle coincides
20 with the centre of the inlet or outlet channel. The mentioned connecting points 10 may be brazing joints but also welding and gluing may, as mentioned earlier, be used as a method of connection.

All the inlet devices 6 and outlet devices 6 may be attached to the same
25 end plate 5. If this is not the case the inlet device 6 for a first fluid and the outlet device 6 for a second fluid for example may instead be attached to a first end plate 5 and the inlet device 6 for the mentioned second fluid and the outlet device 6 for the mentioned first fluid may be attached to a second end plate 5.

Each one of the present end plates 5 may possess an area which is smaller than half the area for one of the heat exchanging plates 1-4 in the core of plates whereby the area without regard to the area enlargement due to corrugations is meant. Two or more end plates of the kind described
5 may be mounted in the same end of the core of plates but in different ends and/or corners of the closest situated heat exchanging plate. The end plates 5 may fluid tightly connect to the core of plates and in the outer borders of the core show edge areas 9 at an angle to the main plane of extension for the plates for contacting and attachment to similar edge
10 areas upon the closest situated heat exchanging plate 1-4 in the core of plates.

The connection part 7 may be cylindrical and have a larger wall thickness than the associated transition part 8. The transition part 8 may be executed
15 in the form of a channel equipped and thus hollow truncated cone or in the form of a channel equipped and thus hollow cylinder. The transition part 8 however does not need to be rotation symmetrical. The transition part 8, the end plate 5 and as a consequence the flange-like edge area 9 are, especially in a corner of the plate heat exchanger, with advantage of
20 mainly the same thickness.

The dimensions for pipes and pieces of joint are standardized. The presence of the transition part 8 makes the preservation of the up to now mainly used dimensions and positions for the connection parts 7
25 possible at the same time as the contact area for the attachment of inlet devices 6 and/or outlet devices 6 to the end plate 5 is moved radially outwards, i.e. "past" a number of in relation to the port channels peripherally situated connecting points 10. The strains upon these exposed

connecting points 10 between plates hereby diminish and the so called tearing forces are neutralized. The thickness of the goods in the end plate 5 may be diminished in comparison with prior art for the same demand concerning the pressure load as before. Hereby also the susceptibility of the construction to thermal cycles and fatigue will diminish.

By the dividing up of the inlet device 6 and the outlet device 6 into a connection part 7 and a transition part 8 also the advantage is achieved that the connection parts 7 may be mounted afterwards after the plate heat exchanger with the transition part 8 have been mounted and have passed the brazing furnace. Hereby space within the furnace is saved since this may be filled more effectively with more cores of heat exchangers at a time, induction brazing may be used and the material within the connecting parts 7 may afterwards be chosen freely.

15

If instead connection part/parts 7, transition part/parts 8 and the end plate 5 are arranged in one piece by pressing of a plane plate especially low manufacturing costs are achieved.

20 The invention is not restricted to the forms of execution shown here but may be varied in accordance with the following patent claims.

Claims

1. A plate heat exchanger for at least two heat exchanging fluids, which heat exchanger is permanently joined and comprises at least one core of
5 plates with corrugated heat exchanging plates (1-4) creating plate interspaces between each other, at least two end plates (5) as well as inlet devices (6) and outlet devices (6) for the heat exchanging fluids and in connection with which
- 10 each one of the heat exchanging plates (1-4) is equipped with at least four port holes creating an inlet channel and an outlet channel through the core of plates for each one of the fluids,
- at least one of the end plates (5) is equipped with at least one port hole
15 communicating with an inlet channel or an outlet channel and
- the inlet channels and the outlet channels for a first and a second fluid, respectively, are in fluid communication with a first and a second set, respectively, of plate interspaces
- 20 c h a r a c t e r i z e d i n t h a t
- at least one of the mentioned inlet devices (6) and outlet devices (6) comprises both a connection part (7) equipped with a channel and
25 a transition part (8) with an envelope surface and equipped with a channel, the channel in the transition part (8) fluid tightly connecting the channel in the connection part (7) with the mentioned port hole in one of the end plates (5) and

- an intersectional line between an imaginary elongation of the mentioned envelope surface, in the direction of the generatrix for the envelope surface in every point of contact between the envelope surface and the end plate (5) on one hand and a plane comprising areas of contact in the plate interspace between the two heat exchanging plates (1, 2) that are closest to the transition part (8) in the core of plates on the other hand circumscribes a plurality of connecting points (10) between the mentioned two heat exchanging plates (1, 2).
2. A plate heat exchanger according to claim 1 at which an intersectional line between an imaginary elongation, starting from a line of contact between the mentioned envelope surface and the end plate (5) in a direction which is at right angles with the plates (1-5), of the envelope surface of the transition part (8) on one hand and the mentioned plane comprising surfaces of contact in the plate interspace between the heat exchanging plates (1, 2) that are closest to the transition part (8) in the core of plates on the other hand circumscribes a plurality of connecting points (10) between the mentioned two heat exchanging plates (1, 2).
3. A plate heat exchanger according to any of the preceding claims at which the mentioned intersectional line circumscribes 2-200, preferably 3-100 and most preferred 5-50 connecting points (10).
4. A plate heat exchanger according to any of the preceding claims at which the mentioned intersectional line circumscribes connecting points (10) which are present mainly evenly distributed over the existing plate areas around the inlet channel or the outlet channel in an undivided circular sector with a central angle of at least 90 degrees, preferably more

than 225 degrees and most preferred 360 degrees where the centre of the circle coincides with the centre of the inlet channel or the outlet channel.

- 5 5. A plate heat exchanger according to any of the preceding claims at which the mentioned connecting points (10) are brazing joints.
6. A plate heat exchanger according to any of the preceding claims at which the mentioned transition part (8) is made in one piece with the end plate (5).
- 10 7. A plate heat exchanger according to any of the claims 1-5 at which the mentioned transition part (8) is executed in one piece with the associated connection part (7).
- 15 8. A plate heat exchanger according to any of the preceding claims at which all the inlet devices (6) and the outlet devices (6) are connected to the same end plate (5).
- 20 9. A plate heat exchanger according to any of the preceding claims at which the inlet device (6) for the first fluid and the outlet device (6) for the second fluid are connected to a first end plate (5) and the inlet device (6) for the second fluid and the outlet device (6) for the first fluid are connected to a second end plate (5).
- 25 10. A plate heat exchanger according to claim 9 at which each one of the end plates (5) shows a surface area which is less than half of the surface area of one of the heat exchanging plates (1-4) in the core of plates and where the end plates (5) are both mounted in the same end of the core

of plates but in different ends of the closest situated heat exchanging plate (1).

- 5 11. A plate heat exchanger according to any of the preceding claims at which the end plates (5) fluid tightly connect to the core of plates and in their outer edges show edge areas (9) at an angle to the main plane of extension of the plates (1-5) for contacting and permanent attachment to similar edge areas on the closest situated heat exchanging plate (1) in the core of plates.
- 10 12. A plate heat exchanger according to any of the preceding claims at which the mentioned connection part (7) is cylindrical and of a larger wall thickness than the associated transition part (8).
- 15 13. A plate heat exchanger according to any of the preceding claims at which the mentioned transition part (8) has the form of a hollow truncated cone.
- 20 14. A plate heat exchanger according to any of the preceding claims at which the mentioned transition part (8) has the form of a hollow cylinder.

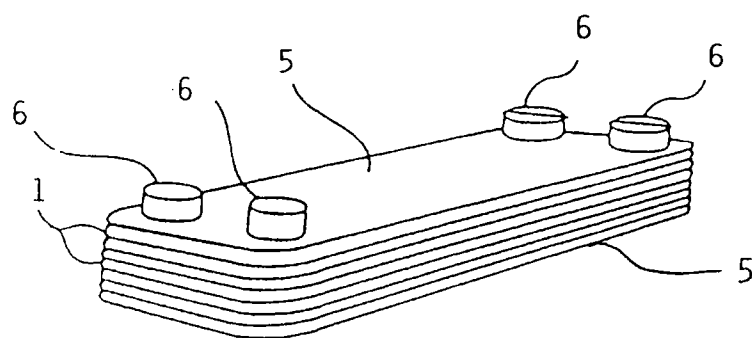


Fig. 1

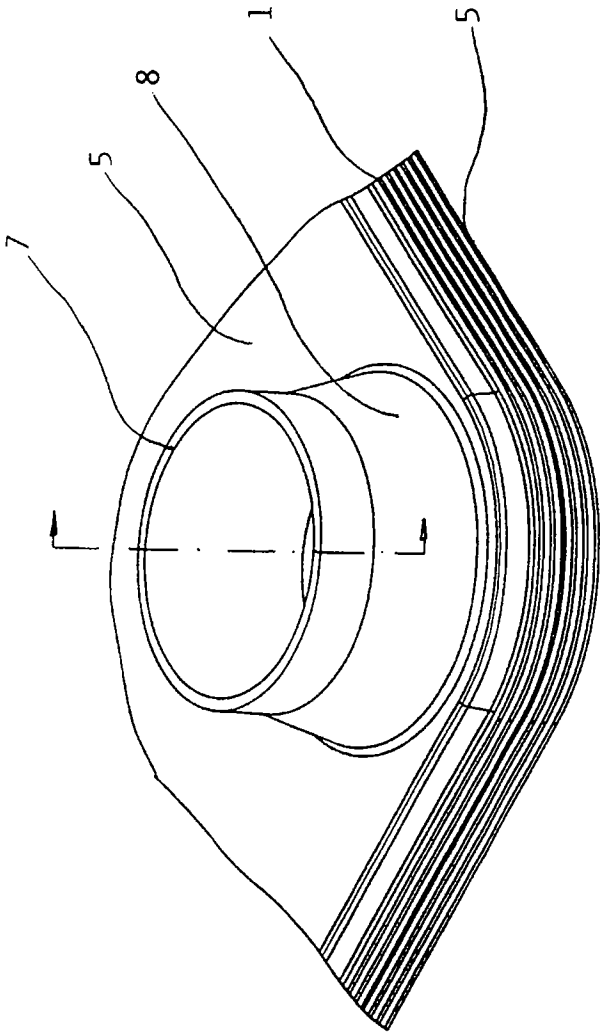


Fig. 2

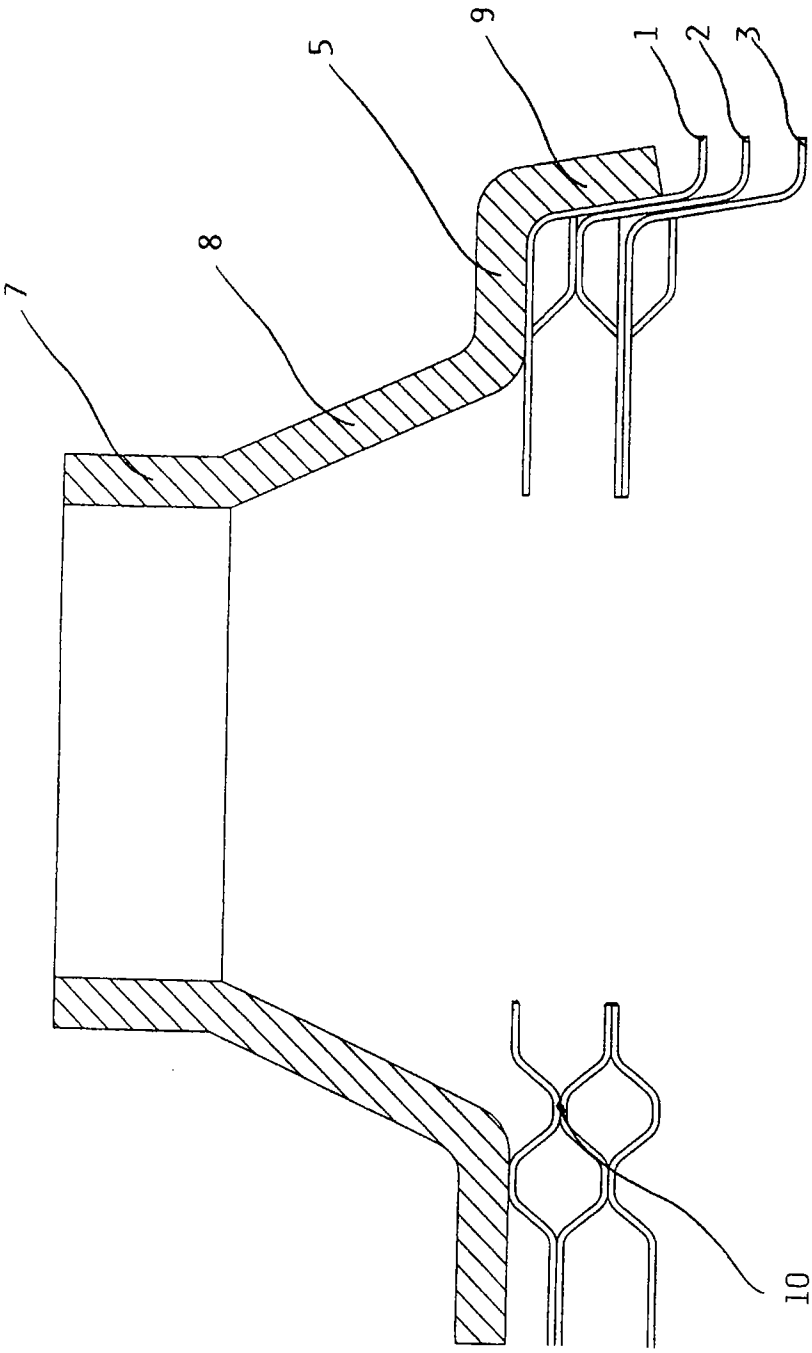


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 98/01214

A. CLASSIFICATION OF SUBJECT MATTER		
IPC6: F28D 9/00, F28F 9/02 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
IPC6: F28D, F28F		
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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

27/07/98

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